课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	先进薄膜制备技术 Advanced Thin film Technology
2.	**授课院系 Originating Department**	材料科学与工程系 Department of Materials Science and Engineering
3.	**课程编号 Course Code**	MSE407
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	春季 Spring
7.	**授课语言 Teaching Language**	英文 English
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	谷猛副教授 Prof. Gu 材料科学与工程系 Department of Materials Science and Engineering gum@sustc.edu.cn 13510596796
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
学时数 Credit Hours	48				48

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	PHY105B 大学物理（下）B General Physics II B MSE001 材料科学与工程基础 Fundamentals of Materials Science and Engineering MSE002 材料科学与工程基础实验 Experiments for Fundamentals of Materials Science
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为微电子学专业选修课，是 LED，太阳能电池，集成电路等微电子领域重要的先修课程；其他材料学等专业学生如果想学习薄膜制备工艺及分析测试方法，也可以选修本课程。 This course should be taken by everyone contemplating doing Microelectronics in the following years and it is a prerequisite for the area of LED, Solar Cells and Integrated Circuit. It should however also be suitable for non-specialists, i.e. for all those students who wish to take a second course in thin film fabrication processes and its characterization.
14.	其它要求修读本课程的学系 Cross-listing Dept.	

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

薄膜材料是现代工业的重要材料形式，广泛应用于能源、汽车、电子、新材料等各种行业之中。本课程主要介绍基于现代电子工业技术中两大类薄膜制备技术，化学气相沉积技术和物理气相沉积技术。化学气相沉积技术包括等离子体增强化学气相沉积技术、金属有机化学气相沉积技术、常压化学气相沉积技术、低压化学气相沉积技术。物理气相沉积技术包括磁控溅射镀膜技术、电子束和热蒸发沉积技术、原子层沉积技术。课程主要讲授以上各种薄膜沉积技术的工作原理、典型装置结构、功能、产线工艺技术以及工艺控制。其中等离子体放电是本课程的核心内容。课程还将讲述薄膜沉积技术的发展趋势。

Thin film is one of the most important materials, which is generally utilized in almost all sectors of society, such as energy, vehicles, electronics and novel materials. This course will introduce some key thin film coating techniques, including plasma enhanced chemical vapor deposition(PECVD),magnetron control sputtering, metal-organic chemical vapour deposition (MOCVD),E-beam evaporation, thermal evaporation, atomic layer deposition and etc. it is delivered in this course that the working mechanism, typical structure of those equipment, functions, process and process control in line. Plasma discharge technology is the core fundamental of this course. The trend of thin film deposition techniques will also be demonstrated.

16. 预达学习成果 Learning Outcomes

掌握等离子体的基本概念，等离子体粒子动力学基本概念，直流等离子体放电的几个关键过程和 Townsend 放电模型。了解等离子体放电的空间电荷区概念、鞘层的行程过程。熟悉基于等离子体技术的薄膜沉积技术，如溅射与磁控溅射、等离子体增强化学气相沉积、电弧沉积等。掌握真空环境下粒子动力学基本概念，熟悉真空热蒸镀的几种薄膜沉积技术，如普通热阻蒸发、电子束蒸发、激光烧蚀沉积、分子束外延等。熟悉金属有机源化学气相沉积技术和原子层沉积技术。了解电镀和溶胶凝胶等溶液薄膜制备技术。

After learning this course, the students should master the basic concepts of plasma and its relative kinetic theories, as well as the typical stages of DC plasma discharge and the Townsend discharge mode. Basing on the basic concepts learned, the students should understand the space charge region and sheath shaping course of plasma. Then, the plasma discharge based thin film deposition techniques should be known, including sputtering and magnetron controlled sputtering, PECVD, Arc discharge deposition. After completing this course, the students should master the

basic concepts of particles' kinetic theory in vacuum. The thermal evaporation in vacuum based techniques should be well learned, including resistance thermal evaporation, e-beam evaporation, laser ablation and molecular beam epitaxial. Metal organic sources based deposition technologies, such as MOCVD and ALD, should be also understood. Solution based deposition techniques should be learned too, such as electro-plating and sol-gel.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

第一讲 绪论（3 学时）
1. 薄膜材料的重要应用
2. 薄膜器件
3. 薄膜技术的分类求
第二讲 热蒸镀（3 学时）
1. 热蒸镀的基本原理
2. 热蒸镀的应用
第三讲 电子束蒸镀（3 学时）
1. 电子束蒸镀基本知识
2. 电子束蒸镀的优势和问题
3. 电子束蒸镀的举例应用
第四讲 磁控溅射 （6 学时）
1. 磁控溅射的基本原理
2. 磁控溅射的应用和影响因素
3. 磁控溅射射频生长绝缘材料
第五讲 脉冲激光镀膜 （6 学时）
1. 脉冲激光镀膜的基本原理
2. 脉冲激光镀膜生长氧化物
3. 脉冲激光镀膜的控制因素
4. 脉冲激光镀膜的原子精度
5. 脉冲激光镀膜的发展历史和优缺点
第六讲 MBE 原子层沉积（6 学时）
1. MBE 的基本原理
2. MBE 的精度和影响因素
第七讲 CVD 化学气相沉积 （9 学时）
1. CVD 的基本知识和生长薄膜原理
2. CVD 生长薄膜的关键控制因子介绍
3. CVD 的优劣势和分支
4. CVD 在工业中的应用
第八讲 ALD 原子层气相沉积 （6 学时）
1. ALD 的基本工作理论
2. ALD 局限性和精度影响因素
3. ALD 在工业界应用
第九讲 纳米薄膜材料与器件（3 学时）
第十讲 MEMS 器件的生长设计（3 学时）

18. 教材及其它参考资料 Textbook and Supplementary Readings

1. Materials Science of Thin Films, 2nd Edition, Milton Ohring, 2001, Academic Press. Handbook of
2. Deposition Technologies for Films and Coatings, William Andrew, 3rd, 2009

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		0		
课堂表现 Class Performance		0		
小测验 Quiz		20		
课程项目 Projects		0		
平时作业 Assignments		0		
期中考试 Mid-Term Test		30		
期末考试 Final Exam		50		
期末报告 Final Presentation		0		
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

☑A. 十三级等级制 Letter Grading
☐ B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority